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REPORT OF

1928 WESTERN PINE BEETLE SURVEY

KLAMATH INDIAN RESERVATION, OREGON

by

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SUMMARY

1. The following report covers the third annual pine beetle survey of the north half of the Klamath Indian Reservation, Oregon. There is also included in this paper an estimate of the annual and total beetle losses for the six-year period, 1923 to 1928 inclusive.

2. Since 1923 the volume and per cent of stand killed on the survey area has been as follows:

Year	Volume in Board Feet	Per cent of Stand
1923	21,574,000	.48%
1924	56,070,000	1.24%
1925	83,475,000	1.85%
1926	119,950,000	2.66%
1927	98,333,000	2.11%
1928	71,518,000	1.54%
Total	450,920,000	9.38%

During the six-year period just past the accumulated losses over the entire area, including both the epidemic and endemic units, have approximated nearly 10% of the merchantable stand. The loss in 1926, which marked the peak of the epidemic, was about 2.7% of the stand. A decline in the infestation started with the 1927 loss, when 2.1% of the stand was killed. In 1928 the annual loss dropped to 1.5% of the stand. The greatest losses have occurred on the Black Hills unit where, for the past six years, a total of 18.3% of the stand has been killed. On some areas of this unit the total losses have amounted to more than 50% of the stand.

3. The status of the present infestation is about the same as that of previous years, except that there has been a general slight decrease in losses over the entire area. The heaviest losses are still on the Black Hills and Calimus Units.

4. The greatest decline in the infestation has occurred on the Taylor Butte, Wocus Bay and Yamsay units. The decline in these units is undoubtedly due to recovery of the trees from the effects of previous Coloradia pandora defoliations. The per cent reduction on these units since 1926 has been 39%, 74% and 47% respectively.

5. The general decline now in progress over the entire area may continue during the next year. It is quite possible that a great subsidence of the infestation will occur during the next few years. This result is already indicated by the low ratio of the 1928 winter broods as compared to the summer broods of this season. This ratio of 135:85 indicates that a decrease of at least 36% is to be expected in 1929.

6. Past control work conducted by the Long-Bell Company on its own lands resulted in a substantial reduction of the infestations on the areas treated. The control work of the years 1924 to 1926 inclusive resulted in decreasing the preceding annual losses 40%, 51% and 36% respectively. The fact that these reductions were secured at a time when the infestation on other adjacent areas was increasing makes them the more striking. Recent control work carried out by this company in the spring of 1928 resulted in reducing the 1928 loss 85% on the areas worked.

7. Early control work by the Indian Service is contemplated on three units--Black Hills, Bottle Springs and Long Creek. The first control work will be carried out on the Black Hills unit. These operations will be started during the current field season.

8. Two plans of future management are suggested:

(1) To inaugurate artificial control work in the highly epidemic areas;

(2) To log the areas nearest present railroad transportation where excessive losses are being sustained, salvaging the recently-killed timber and at the same time removing a high percentage of the infestation.

At the present time artificial control appears advisable, and is recommended, on the Black Hills, Bottle Springs and Long Creek units. The combined plan of salvage and control is suggested for the south halves of the Black Hills and Calimus units only.

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Introduction

According to the plan adopted in 1926, providing for an annual survey of the north half of the Klamath Reservation, the third annual survey of this region was made by the writer in September 1928. An annual examination of the western yellow pinestands of this area is made important by the fact that one of the most aggressive western pine beetle infestations at present known has been in progress in these stands for the past six years. The data on the progress of this infestation are of value from an investigative standpoint, while the loss data are of interest to the owners of the timber. The results of this last survey are of special value to the Indian Service, since control work is to be undertaken on a part of the area during the current year. The owners of the Long-Bell tract, which is within the area surveyed, are also interested in these data, since they have been carrying on control operations on their own lands and expect to continue this work. The main purpose of this report is to supply information on the recent developments to the owners of the timber involved.

The present paper is the third annual report on the barkbeetle infestations of this region.

The Area

The description of the area, timber characteristics etc., was given in both previous reports, which were submitted to the owners. Since these details have already been discussed, only a brief description of the area will be given here.

The area surveyed may be briefly described as that part of the reservation situated north of Sprague River, and between the Sycan Marsh on the east and the Applegate Buttes and the Klamath Marsh on the west. It includes the legal land subdivisions of Townships 29 S to 35 S, between Ranges 8 and 14 E. The extent of the timbered area is approximately 610 square miles or 390,000 acres of western yellow pine. Of this acreage 315,000 acres are Indian land under the administration of the Indian Service, and 75,000 acres are private land owned by the Long-Bell Company. The estimated stumpage of the yellow pine which is susceptible to beetle attack is four and one-half billion board feet, the present value of which is not less than $7 per M.

Survey Methods Used

Check sections were established and cruised in each infestation unit. These check sections were intensively cruised and all trees killed by beetles in 1927 and 1928 were tabulated. In addition strip counts of the same yearly losses were made through representative areas of the forests. This information was further supplemented by strip counts made along all roads traversed.

History of Past Infestations

The history of the infestations which existed on the areas previous to 1927 was given in detail in the report submitted last year. It is sufficient for the present report to state that these infestations have been of a highly epidemic character, with consequent great yearly losses. These losses have aggregated, between the years 1923 and 1926 inclusive, a total of 281,000 MBM. The peak of the infestation was reached in 1925, with a loss for that year of 120,000 MBM. Since that time the infestation has declined slightly, the losses in 1927 and 1928 being 98,000 and 71,000 MBM respectively. During the six-year period from 1923 to 1928 the annual losses have totaled a volume of 451 million board feet. This loss represents 9.88% of the susceptible yellow pine stumpage.

The total board feet killed on the area each year during the last six years are given in the following table:

Year	Volume in Board Feet	Per cent of Stand
1923	21,574,000	.48%
1924	56,070,000	1.24%
1925	83,475,000	1.85%
1926	119,950,000	2.66%
1927	98,335,000	2.11%
1928	71,518,000*	1.54%
Total	450,920,000	9.88%

*Note: This volume is approximate only. At the time the data on the 1928 loss were secured the 1928 loss was not fully apparent, some of the late-fall-attacked trees being still green. However, it is believed that the estimate is very close.

The past as well as the present losses are due almost entirely to the western pine beetle, Dendroctonus brevicomis. While other bark-beetles--the mountain pine beetle, Dendroctonus monticolae, the engraver beetles, Ips spp., and flathead borers--are also common and present in large numbers, the infestation consists primarily of the western pine beetle.

The Present Infestation

The present losses are not uniform over the infested area. A great variety in the intensity of the infestation is found even in individual units. For instance, the 1928 seasonal loss in all the northern units runs through the entire scale, from a minimum of about 25 trees to over 300 trees per section. Most of the southern units are still very heavily infested, averaging from 400 to 700 trees per section.

The intensity of the present infestation varies with site, soil conditions and type of stand. In general the heaviest losses, as in the past, are to be found in the pure yellow pine type on the drier south exposures. One exception, however, is found on the north slopes of the Black Hills, where occurs the most aggressive infestation at the present time. The most severe losses of former infestations, during the period 1923 to 1926, also occurred on these same areas. The highly epidemic centers have shifted very little since the beginning of the infestation cycle.

Since 1926 there has been a decline in the infestation on all the units. This decline on the eastern and southern units has been gradual, with only slight yearly reductions in losses, while on the other units it has been greater and more sharply defined. For instance, the losses on the Black Hills unit dropped from 48,000 MBM in 1926 to 28,000 MBM in 1928, a decline of 42%; while on the Focus Bay unit the decline during these same years was from 14,600 MBM to 3,800 MBM, a reduction of 74%.

It is significant that the greatest decline of the beetle losses during the past two years has occurred on those areas where the trees have shown the most rapid recovery from the effects of the Pandora defoliations of 1918 to 1924. Cores from trees in the stands on the Focus Bay, Taylor Butte, and part of the Yamsay units, show that their annual growth rate is again near normal. The 1927 and 1928 beetle-loss figures for these units show a greater relative decline of the beetle infestation than has occurred on any of the other units.

The present infestation on the greater part of the Long-Bell tract is decidedly less than on adjoining Reservation lands--a condition which is the result of the control work done by the owners during the last four years. On certain areas of this tract, the north Sycan and the south slope of Yamsay Mountain--areas which have not recently been given protection by control work--the losses since 1926 have been much greater than on the areas where recent control work has been carried out.

In general, the infestation since 1926 has shown a decided downward trend, and the indications are that this decline will continue.

The attached map shows the intensity of the present (1928) infestation in terms of trees killed per section.

Conditions by Units

The following infestation units were made in the survey of 1926, and since then no developments have occurred that would necessitate a revision of the boundaries.

A - Long Creek

Previous to 1927 there was a wide variation in the intensity of the infestation on this unit. However, during the past two years the infestation has become more uniform throughout the eastern half, though there is still concentration in the stands bordering the Sycan Marsh. The

heaviest infestation is mostly on Indian lands, though it extends into the Long-Bell tract for a distance of two miles. The western half of the unit is only slightly infested. The control work carried out by Long-Bell in 1926 on its own lands was successful in checking an increase in infestation on the treated lands in a year when an increased infestation was general over the region. However, the infestation of the present season shows an increase in the number of trees attacked on the control areas. The data secured in the survey show that the increase on these lands was due to a shifting from uncontrolled areas rather than to an increase in the infestation, since the 1928 beetle loss is 23% less throughout the entire unit than was the 1927 loss.

The check section cruised shows a loss of 170 trees in 1927 and 130 trees in 1928.

B - Bottle Spring

The season of 1926 marked the peak of the infestation on this unit. A decline in yearly losses began in 1927 and during the season just past a further decline of 33% occurred. The present infestation on this area, while still epidemic in character, is not so aggressive as formerly. Control work was carried out by Long-Bell in the northwestern part of the unit during the spring period of 1928. The effects of this work are strikingly apparent on the treated areas. The 1928 loss on these lands will not average more than 30 attacked trees per section.

During 1927 and 1928 there was a loss of 168 and 128 trees respectively on the check section cruised.

C - Black Hills

Epidemic conditions continue to exist on this unit, the loss for 1928 representing about 3.1% of the stand. The infestation on this area has declined at a consistent but slight rate since 1926. This indicates that the susceptible trees are being killed, and it is to be expected that the losses will continue on this downward course.

As in other areas of this region, the peak of the beetle losses occurred in 1926, with a loss during that year of 48 million board feet. In 1927 the loss amounted to nearly 39 million, and in 1928 it was 28 million board feet. During the six-year period from 1923 to 1928 inclusive the combined annual barkbeetle losses on this unit ~~will~~ have totaled 161 million board feet, or 18.31% of the merchantable stand. While these great losses have been largely concentrated on areas of poor site conditions, the stands on the better sites have also suffered high losses, averaging over 300 trees per section on the latter areas.

The owners of the timber on this unit, the Klamath Reservation, plan to start control operations during the current fall season in the north half of the unit, where the infestation is most severe.

The check section cruised showed a loss of 815 trees in 1927 and 762 trees in 1928. This is a reduction since 1927 of only 6.6%.

D - Calimus Butte

There has been no change during the past three years in the distribution of the infestation on this unit. It has, in common with that on the other units of the area, declined slightly from the high peak reached in 1926. However, the decline has been less than 25% during the past two years, and the present infestation is still highly epidemic. A great reduction in losses is not expected to occur on this unit within the next two years.

The two check sections cruised in the 1928 examination showed the following comparable losses:

1927	1 - 432	trees
	2 - 135	"
1928	1 - 518	"
	2 - 96	"

E - Taylor Butte

During the season just past the character of the infestation in this unit has undergone a radical change. It has decreased 46% since 1927, and is no longer aggressive. This large decrease indicates recovery of the trees from the effects of the Pandora moth defoliations, and examination of the annual rings shows that the growth for the past two years has been nearly normal. A further decrease is expected in the infestation on this unit.

The check section cruised showed a loss in 1927 of 220 trees and in 1928 of 131 trees.

F - Applegate

The present infestation is slightly greater than that of 1926, though 21% less than the 1927 loss. Owing to the poor site conditions the infestation on this unit will perhaps persist in epidemic form longer than on other units of the area. Very high losses occurred in 1927 and 1928 on the hilly portion adjoining the Klamath Marsh. The cutting operations now in progress in the western parts of the unit will no doubt decrease the losses in the standing timber by drawing beetles to the logging slash.

On the check section cruised there was a loss in 1927 of 243 trees and in 1928 of 206 trees.

G - Wocus Bay

The infestation on this unit is rapidly assuming a normal status. The peak was reached in 1926 with a loss of 14,500 MBM, representing 2.5% of the merchantable stand. A sudden drop of 56% occurred in 1927. This sharp decline was followed by a further decrease of 59% in 1928. This downward trend was pointed out last year, and at that time it was predicted that conditions would continue to improve, since the vigorous nature of these stands has enabled the trees nearly to regain their normal growth rate following the last severe defoliations by the Pandora. Conditions comparable to these are found on only two other units of the survey area--Taylor Butte, and in a lesser degree on parts of the Yamsay unit.

H - Yamsay

The ownership of the timber on this unit, like units A and B, is divided between the Long-Bell Company and the Reservation. The present infestation, while still epidemic on local areas, has on the whole declined, resulting in substantial yearly decreases from the high point in 1926. The areas of present high losses, like those of past years, are situated on the southwest slopes of Yamsay Mountain. Outside of these areas the present infestation is endemic, with consequent light annual losses. The recovery of the trees from recent Pandora defoliations has been a factor here, as in other areas, in the reduction of the infestation. Control work carried on by the Long-Bell Company has also been of value in effecting the reduction.

A striking demonstration of the effect of control work is shown on those areas north and south of Deep Creek on the Long-Bell tract. Control operations were conducted last spring south of this creek, but no work was done in the stands north of it. The difference in the seasonal losses of 1928 on these two areas is quite pronounced. The number of trees attacked in 1928, following the control operations, on the worked area does not average more than 50 trees per section, while the same seasonal loss on the unworked area north of the creek averages nearly 200 trees per section.

RECOMMENDATIONS

Probable Future Developments

The peak of the epidemic was reached on the survey area in 1926. Since that year there has been a consistent decline in beetle losses on most of the units. This decline has been most marked in those units where the most severe defoliations of the Pandora epidemic of 1913 to 1924 occurred. On many of the other units the great impetus of the beetle epidemic has so far been able to maintain high yearly losses. Although these losses may decrease as much as 50% within the next generation of beetles (a decrease indicated by the low ratio of the winter broods as compared with the summer broods of the past season), they will remain sufficiently great to deplete seriously the present stands. Even though this 50% reduction from the preceding annual losses takes place each year, there will still be a large annual toll taken from the attacked stands. On this basis the losses would be somewhat as follows, taking the Black Hills unit as an example: the 1928 losses on this unit amounted to 27,810 MBM. A 50% reduction in 1929 would still represent a loss of approximately 14,000 MBM, and this in turn would be reduced to 7,000 MBM in 1930. While this would represent a very marked reduction from the 1928 loss, yet the stumpage value of this 1930 loss would represent $49,000.

On the other hand, there may be an increase in the infestation in 1929, similar to that of 1924. Since this result is not improbable, future predictions are highly speculative.

It is possible, though hardly probable, that the decline will be more rapid than the rate mentioned. But even if this proves to be so the amount of stumpage that will be killed in the next few years will greatly deplete the already thinned stands.

On these units where the beetle population during the peak of the epidemic was much less than on the Black Hills unit, the normal status will be reached sooner; and since the annual losses on these areas never equaled those of the highly aggressive infestations, the losses during the past few years will not be high.

Suggested Management

Two separate courses of action designed to reduce future beetle losses on these areas are possible and are suggested for the consideration of the owners of the timber involved.

Control Work

(1) The inauguration of control work to bring about a rapid reduction of the infestation.

Logging

(2) The logging of the units where the infestation is still aggressive and where the greatest annual losses are occurring.

The first plan seems the only remedy where the present infestation is aggressive and likely to retain this status for the next few years, or where the involved stands are far removed from present railroad transportation. The units where this plan of action would seem most advisable at present are the Long Creek, Bottle Spring, and the north half of the Black Hills.

Control work in the past has amply demonstrated its value. The present infestation on the greater portion of the Long-Bell tract is much less than that on adjoining Reservation lands, a condition directly due to the control work carriedout on these lands during the past four years. The cost of these operations has been more than offset by the value of the timber saved during the period.

The infestation on the areas suggested for control operations is at present declining, and it is expected that this trend will continue. However, during the transition period from epidemic to endemic conditions a great deal of stumpage will be killed which can be saved by early control work.

A limited amount of Federal funds is now available for control work on Reservation lands. Advice from the Indian Service is to the effect that the first control work made possible by these funds will be located in the northern part of the Black Hills unit. These operations will be begun during the current fall period. It is suggested here that these operations be spread over the Bottle Springs and Long Creek units during the spring period of 1929.

The second plan, that of logging the infested stands, would seem advisable on the south halves of the Black Hills and Calimus units and the marsh region of the Applegate. The advantage of this plan lies in the salvage of recently-beetle-killed trees and those that will be killed during the next generation period. It would of course reduce the infestation during the periods when infested trees were being removed from the stands.

This combined method of salvage and control is being given a practical test on both private and Government-owned lands in the Modoc National Forest of northern California. A study of this project would determine whether its application is practical on the areas under consideration.

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Palo Alto, California,
October 20, 1928.

TABLE I

YELLOW PINE BEETLE LOSSES FOR 1927

Unit	Acres	Stand MBM	Killed in 1927		% of Stand
			Trees	Volume (MBM)	
A. Long Creek	25,600	307,200	4,550	4,550	1.48%
B. Bottle Spring	32,720	432,000	5,250	5,409	1.25%
C. Black Hills	73,600	883,200	45,000	38,700	4.61%
D. Calimus Butte	81,900	982,800	34,200	26,560	2.70%
E. Taylor Butte	28,800	345,600	8,500	6,800	1.97%
F. Applegate	19,200	230,400	4,700	3,760	1.63%
G. Wocus Bay	51,200	614,400	6,200	6,200	1.01%
H. Yamsay	74,000	864,000	8,060	6,354	.73%
	387,020	4,659,600	114,460	98,333	2.11%

TABLE II

ESTIMATED BEETLE LOSS FOR 1928

Unit	Acres	Stand MBM	Killed in 1928		% of Stand
			Trees	Volume (MBM)	
A. Long Creek	25,600	307,200	3,490	3,490	1.13%
B. Bottle Spring	32,720	432,000	4,020	3,618	.84%
C. Black Hills	75,600	883,200	39,900	27,810	3.15%
D. Celimus Butte	81,900	982,800	27,100	21,680	2.21%
E. Taylor Butte	28,800	345,600	4,800	3,840	1.11%
F. Applegate	19,200	230,400	3,700	2,960	1.28%
G. Wocus Bay	51,200	614,400	3,800	3,800	.62%
H. Yamcay	74,000	864,000	4,800	4,320	.50%
	387,020	4,659,600	82,610	71,518	1.54%

TABLE III

BEETLE LOSSES FOR 1927 AND 1928 ON UNITS OF JOINT OWNERSHIP

Unit	Ownership	Acreage	Killed in 1927 Volume in B.F.	Killed in 1928 Volume in B.F.
A. Long Creek	Long-Bell	16,000	2,000,000	1,540,000
	Reservation	9,600	2,550,000	1,950,000
B. Bottle Spring	Long-Bell	14,720	1,449,000	828,000
	Reservation	18,000	3,960,000	2,790,000
C. Yamsay	Long-Bell	23,000	2,504,000	2,520,000
	Reservation	51,000	4,060,000	2,700,000

TABLE IV

ESTIMATED BEETLE LOSSES FOR SIX YEARS - 1923 TO 1928

Unit	Stand MBM	Volume in MBM Killed						Total Killed	% of Stand
		1923	1924	1925	1926	1927	1928		
A. Long Creek	307,200	1,600	4,800	5,200	4,600	4,550	3,490	22,240	7.24%
B. Bottle Spring	432,000	1,890	4,095	5,490	6,930	5,409	3,618	27,432	6.35%
C. Black Hills	863,200	6,159	14,930	26,100	48,000	30,700	27,810	161,679	18.51%
D. Calimus Butte	982,800	4,320	13,800	23,000	28,800	26,560	21,680	118,160	12.02%
E. Taylor Butte	345,600	1,440	3,240	5,500	6,290	6,800	3,840	26,910	7.80%
F. Applegate	230,400	960	1,920	1,720	2,640	3,760	2,960	13,960	6.06%
G. Focus Bay	614,400	3,200	6,400	11,600	14,500	6,200	3,800	45,700	7.44%
H. Yamsay	864,000	2,025	6,885	7,065	8,190	5,354	4,520	34,859	4.03%
	4,659,600	21,574	56,070	83,475	119,950	98,353	71,518	450,920	9.88%